

PATENT SPECIFICATION

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(54) FIXING UNIT FOR AN ELECTROPHOTOGRAPHIC COPYING MACHINE

(71) We, WIFO WISSENSCHAFTLICHES FORSCHUNGSINSTITUT A.G., of 18 Binzstrasse, 8045 Zurich, Switzerland, a Swiss Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a fixing unit for an electrophotographic copying machine of the kind comprising a conveyor band, which extends over end rollers and the upper run of which serves to convey through the unit sheet material carrying toner images to be fixed, and a heater for imparting to the images the heat required to fix them.

In known fixing units of this kind the heater is disposed above the upper run of the band and imparts heat to the images by radiation. To avoid heat losses in the air gap between the heater and the sheet material, this gap must be made as narrow as possible. The size of the gap cannot, however, be less than a given minimum because contact between the images and the heater must be avoided.

The object of the invention is to provide a fixing unit of this kind in which the energy consumption required for thermal fixing of toner images is reduced to a minimum.

The invention accordingly provides a fixing unit for an electrophotographic copying machine, comprising a seamless, perforated metal conveyor band which extends over end rollers and the upper run of which serves to convey through the unit sheet material carrying toner images to be fixed, a heater, including at least one elongate heating element, which is disposed within the zone encircled by the band and serves to heat a portion of the band remote from the fixing area, and a device for maintaining the sheet material in intimate contact with the band.

Certain embodiments of the invention

will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:—

Fig. 1 is a perspective view of a fixing unit according to the invention.

Fig. 2 is a section on the line II-II in Fig. 1.

Fig. 3 is a view showing the disposition of the heating elements in the unit shown in Fig. 1.

Fig. 4 is a sectional view of one of the rollers, and

Fig. 5 is a side view, partly in section of a modified form of fixing unit.

The fixing unit shown in Fig. 1 includes a conveyor 1, a heater 2 (Fig. 3) and a device 3, described in more detail below, for ensuring intimate contact between the upper run of a conveyor band 5 and the sheet material 4 (Fig. 2) carrying the toner images.

The band 5 is a perforated, seamless metal band, made for example of copper, nickel or nickel-cobalt alloy, and is trained around rollers 6, 7. The roller 6 is driven as later explained with reference to Fig. 4. The thickness of the band may be 50-200µm and it may, for example, have perforations in the range of 40 to 150 mesh.

The heater 2 (Fig. 3) consists of at least one heating element which may be an infra red radiator. Such a heating element 8 is shown disposed within the roller 6. The roller 6 is heated by the element 8 and transfers the heat to the band 5, which travels in the direction shown by the arrow in Figs. 1 and 3. When a sheet 4 carrying a toner image comes into contact with the band 5, the heat stored in the band is transferred to the sheet to effect fixing of the image.

One or more further heating elements 9, 10, 11 may be disposed between the rollers 6 and 7 above the lower run of the band. The elements 9, 10 extend transversely to

the direction of the travel of the band, are infra red elements and have reflectors 12, 13 for reflecting the heat onto the lower run of the band. The heater 11 is a resistance heater 5 which contacts the lower run of the band.

An infra red heating element 14 with a reflector 15 may also be disposed alongside the roller 6 as shown in Fig. 3. These heating elements may be used individually 10 or in any desired combination. As will be seen the heating elements are elongate and are disposed within the zone encircled by the band and serve to heat portions of the band remote from the fixing zone. For 15 special purposes an infra red heating element 61 may also be provided externally of the band.

A thermal sensor 16 is provided beyond the fixing area which senses the temperature 20 of the band and effects appropriate control over the heating elements 8, 9, 10, 11 and 14, to ensure that the portion of the band entering the fixing area will be at the correct temperature.

To avoid loss of heat from the rollers 6 and 7 to other parts of the copying machine, they are of the construction shown in Fig. 4. As there shown the roller 6 consists of cylindrical metal shell 17 which is supported, 30 by end caps 18, 19 of thermally insulating material, on a shaft 20 carrying a driving gear 21. The shaft 20 consists of telescoping parts and contains the heating element 8. The other roller 7 is of similar construction 35 but has no driving gear or heating element. To maximise the heat transfer from the band 5 to the sheet 4, the latter is held in intimate contact with the band in the fixing area by suction applied by a suction box 22 40 disposed beneath the upper run 23 of the band and extending for the full width of the band as shown in Fig. 2. The suction box 22, which has a slightly curved, perforated upper surface 28, is supported on members 24, 25 and has in one end well 45 an opening 26 to which suction is applied by a suction fan 27.

Interposed between the upper surface 28 of the suction box and the upper run 23 of the band are a fibrous layer 29, constituted by a fibrous fleece or a woven fabric, a metal sieve 30 which provides protection for the fibrous layer and a perforated foil 31 of low friction plastics material, e.g. 55 polytetrafluoroethylene.

The fibrous layer 29 imposes a certain resistance to the flow of air through the upper run 23 of the band into the suction box 22 which exceeds that imposed by the 60 upper run 23 and the foil 31. The resistance to air flow can be controlled by suitable choice of the fibrous layer. Prior to introduction of a sheet 4 into the unit, the flow of air into the suction tank is restricted only 65 by the resistance imposed by the fabric layer

and it should not be excessive in order to avoid undue cooling of the fixing area.

The flow of air naturally decreases as a sheet passes through the fixing area. The resistance to air flow imposed by the fibrous 70 layer 29 and the nature of the suction fan 27 are such that the sheet 4 is at all times held firmly against the band.

Owing to the temperature prevailing in the fixing area the air sucked out of the 75 suction box 22 is warm. In the case of a small unit the amount of such warm air is small and it may be allowed to escape to atmosphere. In the case of a larger unit, which uses up a substantial amount of 80 energy in heating this air, it is preferred, as shown in Fig. 1, to blow this warm air from above on to the sheets to be fixed. This serves to press the sheets more firmly against the band. 85

Accordingly a blowing box 32 is provided above the upper run 23 of the band. The inlet 33 of the box 32 is connected by a conduit 34 to the fan 27. An additional heating element 35 can, if desired, be provided in the conduit 34. 90

The box 32 has a perforated bottom and contains a deflector plate 36 for distributing the entering warm air over the bottom of the box. To prevent lateral escape of the air 95 passing through the bottom of the box 32, the latter is divided into a central blowing chamber 37 and two side suction chambers 38, 39 which communicate, via a channel 40, with a conduit 41, connected to the inlet 100 of the fan 27 and containing a regulating valve 42 and an auxiliary fan 43.

The side chambers 38, 39 carry plates 44 and 45 which define the outlet and inlet 105 zones for the sheets 4.

To conserve energy it is advisable to enclose the unit in thermally insulating material. For this purpose, as shown in Fig. 5, the band and the rollers may be situated in a well in a block 46 of thermally 110 insulating material, for example asbestos, containing a lining 60 of metal foil, e.g. of aluminium, which serves as a reflector for heat. The blowing box 32 is also surrounded by thermally insulating material 47. 115

The embodiment shown in Fig. 5 includes means for tensioning and maintaining alignment of the band 5. Slip of the band on the driving roller 6 must be avoided and this can be achieved by providing sufficient 120 tension in the band. To this end the shaft 20 of the roller 7 carries ball bearings 48, one only of which is shown in Fig. 5. The outer ring 49 of each bearing engages a shoe 50 on the end of a tensioning screw 125 51, which engages a nut accommodated in a recess in the frame (not shown) of the fixing unit. Springs (not shown) between the nuts 52 and the shoes 50 apply pressure to the roller 7 to tension the band 5. 130

During operation of the unit, the band 5 tends to shift transversely out of proper alignment and this could lead, after a time, to the band contacting the frame of the unit. This is prevented by a device constituted by a D.C. electro-magnet 53, which urges a shoe 56 carried by a rod 54 into contact with the outer ring of a bearing 55 on one end of the shaft of the driving roller 6. Feelers 57 are provided on opposite sides of the upper run of the band 5. When the band moves out of alignment sufficiently to contact one or other of the feelers 57, a signal is sent by a control device 58 to the electromagnet 53 to cause it to move the shoe 56 upwardly or downwardly, as required, and so to tilt the shaft of the roller from its normal horizontal position in the direction to cause the band to return to proper alignment. The tilting movement applied to the roller 6 is so small as to have no disadvantageous effect on the fixing operation.

In operation, the sheet 4 carrying the image to be fixed is fed into the unit by the roller 7. The device 3 presses the sheet firmly against the band 5 to ensure effective transfer of heat from the band to the sheet 4 and rapid melting and fixing of the toner. In the case of fixing images formed by wet development the solvent is rapidly evaporated and the sheet retains a planar configuration, which ensures a good copy. After fixing the sheet leaves the unit between the roller 6 and the guide plate 44.

The heater 2 may include one or more short wave infra red elements and a safety device may be provided for switching off the heater upon stoppage of the band in order to prevent damage to the band. The heating element 11 (Fig. 3) may have on its upper surface a galvanically deposited layer of metal connected to a source of current.

The heat from the heater 2 is transferred directly to the metal band 5, primarily by radiation and partially by conduction, and is thereafter transferred by the band to the sheets carrying the images to be fixed.

As an alternative to the use of suction to hold the sheets firmly to the band it is possible to effect this by applying an electrostatic charge to the sheets or by the provision of spikes on the band. In all cases the sheets are maintained truly planar as they pass through the fixing area.

The above-described heating units are of compact construction, involve relatively small losses of energy and can operate at relatively low temperatures of 60-180°C. The warming up period is short.

There are no parts adjacent the passage for the sheets through the unit which are raised to a sufficient temperature to ignite the sheets, which are normally of paper or

plastics foil, and the unit contains no elements which can contact and smear the images on the sheets.

WHAT WE CLAIM IS:

1. A fixing unit for an electrophotographic copying machine, comprising a seamless, perforated metal conveyor band which extends over end rollers and the upper run of which serves to convey through the unit sheet material carrying toner images to be fixed, a heater, including at least one elongate heating element, which is disposed within the zone encircled by the band and serves to heat a portion of the band remote from the fixing area, and a device for maintaining the sheet material in intimate contact with the band.

2. A fixing unit according to claim 1, which includes an elongate heating element disposed within one of the rollers.

3. A fixing unit according to claim 1 or claim 2, which includes at least one elongate heating element disposed above its lower run.

4. A fixing unit according to any one of the preceding claims, which includes at least one elongate heating element disposed alongside one of the rollers.

5. A fixing unit according to claim 1, which includes means for switching off the heater upon stoppage of the band.

6. A fixing unit according to claim 1, in which each roller includes a cylindrical metal shell which is supported on a shaft by end caps of thermally insulating material.

7. A fixing unit according to claim 1, in which thermal insulation is provided above the upper run of the belt, below the lower run and outside the rollers.

8. A fixing unit according to claim 1, which includes a suction box beneath the upper run of the belt which has a perforated upper wall covered with a layer of fibrous material.

9. A fixing unit according to claim 8, in which the fibrous layer is covered by a perforated foil of low friction plastics material.

10. A fixing unit according to claim 9, which includes a metal sieve between the fibrous layer and the plastics foil.

11. A fixing unit according to claim 8, which includes a blowing box, disposed above the upper run of the band, for discharging on to the band warm air withdrawn from the suction box.

12. A fixing unit according to claim 11, which includes a heater for heating the air supplied from the suction box to the blowing box.

13. A fixing unit according to claim 11, which includes a fan for withdrawing air from the suction box and an auxiliary fan for withdrawing air from the blowing box

and returning it to the inlet of said fan.

14. A fixing unit according to claim 1, which includes a tensioning device for the band which acts on one of the rollers.

5 15. A fixing unit according to claim 1, which includes a device acting on one of the rollers for preventing lateral deviation from alignment of the band.

10 16. A fixing unit according to claim 1, substantially as described herein with

reference to Figs. 1 to 4 of the accompanying drawings.

17. A fixing unit according to claim 1, substantially as described herein with reference to Fig. 5 of the accompanying 15 drawings.

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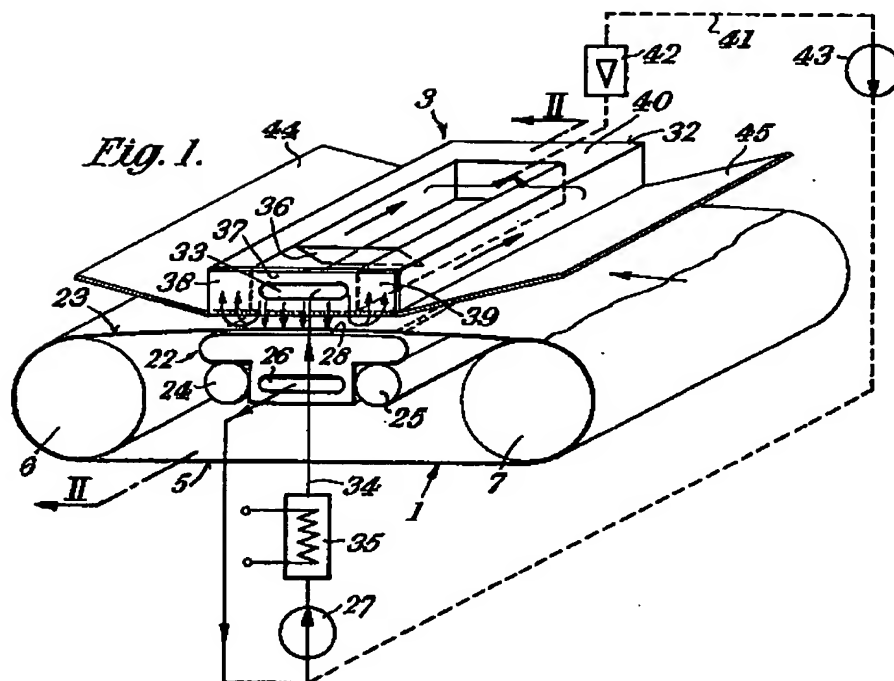
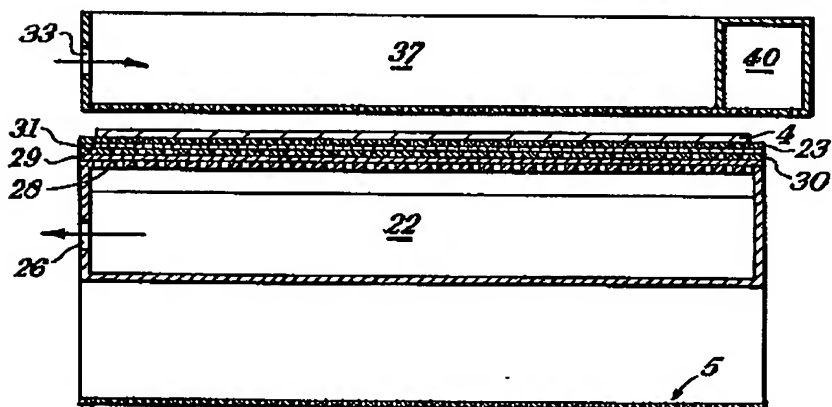


Fig. 2.



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COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of
the Original on a reduced scale
SHEET 2

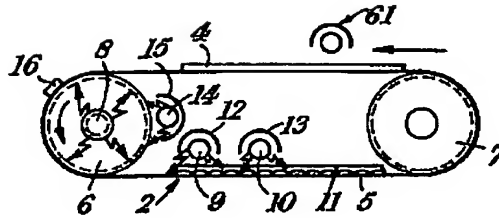


Fig. 3.

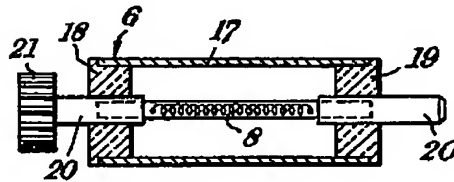


Fig. 4.

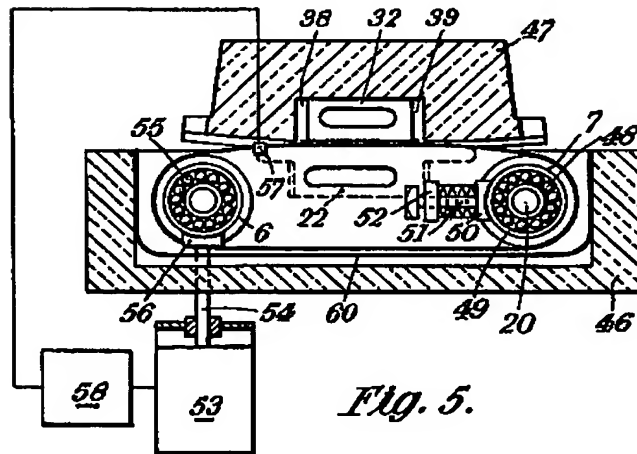


Fig. 5.